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## State Gratitude for One's Life and Health after an Acute Coronary Syndrome: Prospective Associations with Physical Activity, Medical Adherence and Re-hospitalizations

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### Abstract

Gratitude may be associated with beneficial health outcomes, but studies of this association have been mixed, and in these studies gratitude has often been conceptualized as a stable, unidimensional trait. We used four specific items to examine the prospective association of state- and domain-specific gratitude with medical outcomes among 152 patients with a recent acute coronary syndrome. State gratitude for one's health 2 weeks post-event was associated with increased physical activity (measured via accelerometer) 6 months later, controlling for relevant demographic, social, medical and psychological factors ( $\beta=340.9$ ; 95% confidence interval=53.4–628.4;  $p=.020$ ). Gratitude for one's life was associated with increased self-reported medical adherence at 6 months on the maximally adjusted model ( $\beta=.60$ ; 95% confidence interval=.16–1.04;  $p=.008$ ); no gratitude items were associated with rehospitalizations. In contrast, dispositional gratitude, measured by the Gratitude Questionnaire-6, was less dynamic and responsive to change over the 6-month period and was not associated with physical activity.

### Keywords

gratitude; state gratitude; physical activity; health behaviors; medical adherence; rehospitalizations; acute coronary syndrome; cardiovascular disease; appreciation; health psychology; positive psychology

### Introduction

Each year, 1.1 million persons in the United States are hospitalized with acute coronary syndrome (ACS; myocardial infarction or unstable angina) (Benjamin et al., 2017). Around 20% of these patients will be rehospitalized for ischemic heart disease or suffer mortality within the next year (Grech & Ramsdale, 2003). Therefore, it is vital that potentially

modifiable protective factors associated with recovery from ACS are identified to reduce the risk of ACS recurrence and mortality.

Psychological functioning is increasingly recognized as a key element in post-ACS recovery. Indeed, among ACS patients, negative psychiatric syndromes, such as depression and anxiety disorders, have been associated with recurrent cardiac events and death, independent of sociodemographic factors and traditional cardiac risk factors (Huffman, Celano, Beach, Motiwala, & Januzzi, 2013; Roest, Zuidersma, & Jonge, 2012). In step with this evidence, the American Heart Association has declared depression a formal risk factor for poor prognosis following an ACS (Lichtman et al., 2014).

On the other hand, positive affect and optimism have been associated with reduced risk of cardiovascular disease, independent of traditional risk factors and ill-being (Boehm & Kubzansky, 2012). Optimism in particular has been robustly associated with reduced risk of cardiac events (Boehm & Kubzansky, 2012) and with enhanced recovery in the post-ACS period (Huffman et al., 2016; Ronaldson et al., 2015). Psychological well-being may lead to improved cardiac outcomes via superior adherence to key cardiac health behaviors, particularly physical activity (DuBois et al., 2015; Giltay, Geleijnse, Zitman, Buijsse, & Kromhout, 2007; Huffman et al., 2016; Ronaldson et al., 2015; Steptoe, Wright, Kunz-Ebrecht, & Iliffe, 2006), which has been clearly associated with superior outcomes and reduced mortality in those with and without heart disease (Chow et al., 2010; Powell, Thompson, Caspersen, & Kendrick, 1987).

Gratitude may be another important positive psychological construct related to cardiac health. Gratitude is common, powerful, and likely a dynamic psychological experience after an acute medical event such as an ACS – for example, 50% of patients experience increased gratitude for being alive after an ACS (Laerum, Johnsen, Smith, & Larsen, 1988). This is particularly important given that gratitude has been linked to numerous psychological outcomes that may be important in cardiac recovery, including reduced psychopathology (Sirois & Wood, 2017), increased adaptive personality characteristics (McCullough, Emmons, & Tsang, 2002; Wood, Joseph, & Maltby, 2009) and increased positive relationships/social support (Wood, Maltby, Gillett, Linley, & Joseph, 2008).

Despite the prevalence of gratitude following ACS and its potential role in cardiac recovery, however, there are several gaps in the literature related to gratitude and its associations with cardiovascular health. First, within gratitude research, there is a lack of agreement about the exact definition and nature of the construct (Lambert, Graham, & Fincham, 2009; McCullough, Kilpatrick, Emmons, & Larson, 2001; Wood, Froh, & Geraghty, 2010). Some researchers have defined gratitude as an emotion that is directed primarily toward appreciating the helpful actions of other people (McCullough et al., 2001), whereas others have proposed gratitude to be a more global trait that involves a life orientation towards noticing and appreciating the positive in the world (Wood et al., 2010). Next, there is also uncertainty regarding the extent to which gratitude is a stable, dispositional trait versus a psychological state that can vary temporally with life events, experiences and environments (McCullough, Tsang, & Emmons, 2004; Wood, Maltby, Stewart, Linley, & Joseph, 2008). Third, while numerous proposed scales exist, most such scales, such as the Gratitude

Questionnaire 6 (GQ-6) (McCullough et al., 2002), measure gratitude in a general manner and as a dispositional trait. This has resulted in a lack of knowledge regarding domain-specific and state-specific gratitude in clinical populations. Finally, there has been a paucity of research on gratitude's effects on key health behaviors and subsequent outcomes in critical medical periods, such as the period following an ACS.

To address these questions and others, the Gratitude Research in Acute Coronary Events (GRACE) study (Huffman et al., 2015) examined the prospective effects of gratitude, measured 2 weeks post-ACS, on physical activity, medical adherence, and rates of cardiac readmissions during the next 6 months. The GRACE study measured gratitude with the dispositional and well-validated GQ-6 measure and via four novel questions exploring domain-specific state gratitude over the 6 months following an ACS hospitalization. The novel questions inquired about the extent to which a patient felt thankful for (i) their *life*, (ii) their *family/friends*, (iii) their *health*, and (iv) *medical staff* specifically during the previous week.

Accordingly, in this secondary analysis from the GRACE study, we aimed to assess the properties (e.g., distribution of responses, responsiveness to change) of these four 'state' gratitude items. In addition, for items with an adequate spread of responses, we aimed to examine the prospective association of these items, administered 2 weeks post-ACS, with key health outcomes, including objectively-measured physical activity (primary study outcome measure), self-reported health behaviors, and cardiac readmissions, 6 months later.

## Methods

Detailed methods from the GRACE study are described in full elsewhere (Huffman et al., 2015). Briefly, participants (N=164) were prospectively enrolled during admission for ACS at an urban academic medical center between September 2012 and January 2014. To be eligible, patients were required to meet consensus criteria for an ACS (Thygesen et al., 2012). Those with peri-procedural ACS, medical conditions likely to lead to death within 6 months, inability to be physically active, or cognitive impairment precluding consent were excluded. Participants underwent self-report assessments at baseline (2 weeks post-ACS) and at 6-month follow-up and additionally underwent objective assessments for physical activity and readmissions at 6 months. For the analyses of the present study, we included only those participants (N=152) for whom we obtained physical activity data. Baseline characteristics and demographics were collected at the enrollment interview and through review of the electronic medical record at discharge. Approval from our healthcare system's Institutional Review Board (IRB) was obtained prior to commencement of study procedures, and all participants underwent full written informed consent.

## Psychological measures

**Dispositional gratitude**—Gratitude was measured via the well-validated GQ-6 (McCullough et al., 2002)

**State and domain-specific gratitude**—Gratitude was also measured via four statements on which patients rated their agreement, ranging from 1 (strongly disagree) to 7

(strongly agree). These statements were developed by literature review on gratitude scales (Adler & Fagley, 2005; McCullough et al., 2002; Watkins, Woodward, Stone, & Kolts, 2003; Wood et al., 2010) and by joint consensus of psychiatrists, cardiologists, psychologists, and social workers who frequently work with patients in the post-ACS period. They were designed to capture specific elements of gratitude that may be relevant particularly after a hospitalization for a major cardiac event. The items were:

- (1) Over the past week, in general, I have been feeling thankful about my **life**.
- (2) Over the past week, I have been feeling thankful toward my **family and friends**
- (3) Over the past week, I have been feeling thankful about my **health**.
- (4) *Over the past week, I have been feeling thankful about **the doctors, nurses, and other staff** who helped to take care of me when I was in the hospital and afterwards.*

### Psychological covariates

At 2 weeks and 6 months, optimism was measured via the 6-item Life Orientation Test-Revised (LOT-R) (Scheier, Carver, & Bridges, 1994), depression was measured via the Patient Health Questionnaire-9 (PHQ-9) (Kroenke, Spitzer, & Williams, 2001), and anxiety was assessed using the 7-item Hospital Anxiety and Depression Scale Anxiety Subscale (HADS-A) (Bjelland, Dahl, Haug, & Neckelmann, 2002).

### Outcome variables

**Physical Activity (primary outcome)**—Physical activity was selected as the study’s primary outcome measure because it is a key modifiable risk factor in patients with ACS (Chow et al., 2010; Steffen-Batey et al., 2000), and previous studies have found that at least some interventions targeting gratitude have been associated with increased self-reported physical activity (Emmons & McCullough, 2003). To assess physical activity, 2 weeks prior to the 6-month assessment, participants wore a Fitlinxx Pebble accelerometer (Fitlinxx, Shelton, CT). We considered 6 valid days of wear (8 confirmed hours of wear time per day) to be sufficient. If participants failed to achieve adequate step data collection, they rewore the devices.

**Medical adherence**—Broader self-reported adherence to health behaviors (*physical activity, diet, stress reduction, and medication adherence*) was measured using four items from the Medical Outcomes Study Specific Adherence Scale (MOS-SAS) (DiMatteo, Hays, & Sherbourne, 1992). This scale has been used to examine adherence in prior studies of cardiac patients (Bauer et al., 2012; Huffman et al., 2014). For each item, ratings were made on a 1–6 scale ranging from 1 (none of the time) to 6 (all of the time).

**Readmissions**—The main readmissions outcome was nonelective cardiac readmissions, which were triangulated from participants, care providers, and health records at 6 months. Participants were queried about all readmissions at the 6-month follow-up assessment. Study staff also contacted patients’ primary medical or cardiology provider to inquire about

readmissions and their cause over the 6 month interval and reviewed electronic medical records across the participating hospital's healthcare system.

## Data Analysis

**Aim #1: To assess characteristics of responses to the four state gratitude items.**—Descriptive statistics (means, medians, and standard deviations) were calculated for each item. We next discarded any items for subsequent analyses that displayed extreme floor or ceiling effects (i.e., greater than 50% of responses were at the lowest or highest scores on the 1–7 scale) because an ideal measure should not demonstrate significant floor or ceiling scores (Terwee et al., 2007). Next, we used Spearman correlation coefficients to assess correlation between each of the state gratitude items and age, medical comorbidity (Charlson comorbidity index) (Charlson, Szatrowski, Peterson, & Gold, 1994), dispositional gratitude (GQ-6), optimism (LOT-R), depression (PHQ-9) and anxiety (HADS-A). To evaluate differences in state gratitude domain ratings between sexes, a t-test was performed for each state gratitude item. Finally, to examine responsiveness to change of the items compared to related scales, we performed paired t-tests for each over the study period (from 2 weeks post-ACS to 6 months post-ACS) evaluating the magnitude of change of each state gratitude item, the GQ-6, and other psychological scales over this period.

**Aim #2: To examine the prospective association of state gratitude items (2 weeks post-ACS) with physical activity, self-reported adherence, and cardiac readmissions 6 months later.**—We examined associations of each item (aside from those discarded due to extreme ceiling effects) with mean number of daily steps and medical adherence scores 6 months later, via multivariable linear regression. To control for relevant covariates, we used a hierarchical series of four models with increasing covariate adjustment. Model 1 (minimally adjusted) included age and sex as covariates. Model 2 (social and medical factors) included these factors plus a marker of social support (living alone), measures of ACS severity and history (peak troponin T and previous ACS), and medical comorbidities (Charlson comorbidity index). In model 3 (negative psychological factors), we added measures of depression (PHQ-9) and anxiety (HADS-A) as covariates. In model 4, we additionally added optimism (LOT-R) as a covariate to determine if our novel state gratitude domains were distinct from a known positive psychological construct. For analyses using physical activity as the dependent variable, we controlled for baseline physical activity in models 2–4 via the Physical Activity Recall (PAR) measure (Sallis et al., 1985). Finally, to compare physical activity amongst those with the highest levels of state gratitude to those with less gratitude, an identical regression model was created with the corresponding state gratitude item responses dichotomized into 'strongly agreeing' (i.e., score of 7) or not.

Associations between baseline gratitude and 6-month cardiac rehospitalizations were assessed via time-to-event analyses using multivariable Cox regression. We controlled for age and sex in our model; additional covariates were not included because of the risk of overfitting based on the expected rate of re-hospitalization (15%) (Yeo K.K., 2012).

All analyses were performed using Stata statistical software (PC version 11.2, StataCorp, College Station, TX). All tests were 2-tailed. Statistical significance was set at  $p < 0.05$  for all aims, although a conservative correction for multiple comparisons would divide this value by the number of examined items.

## Results

### Characteristics of responses to the four state gratitude items.

Table 1 shows participant characteristics and baseline (2 week) scores on all self-report measures. Two weeks post-ACS, participants reported exceedingly high gratitude toward *medical staff* ( $M=6.62$ ,  $SD=0.89$ ), and *family and friends* ( $M=6.43$ ,  $SD=1.06$ ). In comparison, there were lower mean ratings and more variance in participants' thankfulness for their *health* ( $M=5.52$ ,  $SD=1.57$ ) and *life* ( $M=6.04$ ,  $SD=1.33$ ). Indeed, responses heavily clustered toward "strongly agreeing" (7 out of 7) for feeling gratitude for *medical staff* ( $N=116$ , 76.3%) and *family and friends* ( $N=101$ , 66.4%) whereas only 47.4% ( $N=72$ ) of participants strongly agreed they felt thankful for their *life* and only 29.6% ( $N=45$ ) strongly agreed to feeling thankful for their *health*. Given the observed minimal response variability and ceiling effects for the *family and friends* and *staff* items, additional analyses were completed only for the *life* and *health* gratitude items.

As expected, gratitude for *life* and *health* items showed significant positive correlations with dispositional gratitude (life: GQ-6;  $r_s = 0.53$ ,  $p < 0.001$ ; health:  $r_s = 0.35$ ,  $p < 0.001$ ) and optimism (LOT-R;  $r_s = 0.47$ ,  $p < 0.001$  and  $r_s = 0.31$ ,  $p = 0.001$ ), along with significant negative correlations with depression (PHQ-9;  $r_s = -0.28$ ,  $p = 0.006$  and  $r_s = -0.21$ ,  $p = 0.010$ ). There was a nonsignificant trend toward a negative correlation between *life* gratitude and anxiety (HADS-A;  $r_s = -0.16$ ,  $p = 0.056$ ) and a significant negative correlation between *health* gratitude and anxiety (HADS-A;  $r_s = -0.17$ ,  $p = 0.038$ ). There were no significant correlations between the *life* and *health* items at baseline with participant age ( $r_s = -0.005$ ,  $p = 0.951$  and  $r_s = -0.03$ ,  $p = 0.671$ , respectively) or with medical comorbidity score ( $r_s = -0.052$ ,  $p = 0.523$  and  $r_s = -0.05$ ,  $p = 0.570$ ). There was a nonsignificant trend toward higher gratitude for *life* in women (mean difference = 0.53,  $SE = 0.292$ , 95% CI,  $-0.052$ – $1.10$ ,  $t = 1.80$ ,  $p = 0.074$ ), and men and women were nearly identical in gratitude for *health* ( $-0.061$ ,  $SE = 0.35$ , 95% CI  $-0.74$  to  $0.63$ ,  $t = -0.18$ ,  $p = 0.861$ ).

Changes for each state gratitude item and other psychological measures over the study period are presented in Table 2. Over the 6-month period, gratitude for *life* increased significantly (mean difference = 0.27,  $SD = 1.33$ , 95% CI 0.057 to 0.48,  $t = 2.51$ ,  $p = 0.013$ ) as did gratitude for *health* (mean difference = 0.44,  $SD = 1.59$ , 95% CI 0.19 to 0.69,  $t = 3.42$ ,  $p < 0.001$ ). There were no significant changes in dispositional gratitude (GQ-6) over the 6-month study period. There were also no significant changes over time for dispositional optimism (LOT-R) or anxiety (HADS-A). Depression (PHQ-9) decreased significantly (mean difference =  $-0.949$ ,  $SD = 3.48$ , CI  $-0.150$  to  $-0.40$ ,  $p = 0.001$ ).



### Associations between state gratitude items and medical outcomes.

As above, given the minimal response variability for the *family and friends* and *medical staff* gratitude items, analyses examining these associations were completed only for the *life* and *health* items, which are presented in Table 3. Regarding physical activity, the mean number of steps taken per day at 6 months across all participants was 5,147 steps (SD=2845). Gratitude for *life* was associated with greater number of steps taken, controlling for age and sex (Model 1), and after additionally controlling for medical and social variables (Model 2:  $\beta=359.2$ ; 95% CI, 46.4–672.1;  $p=0.025$ ). This association became marginal however, after additionally controlling for depression and anxiety (Model 3:  $\beta=301.0$ ; 95% CI, –47.1–649.1;  $p=0.090$ ). Overall, compared to those with less gratitude ( $n=80$ ), those with the highest rated gratitude for their *life* two weeks after hospitalization ( $n=72$ ) walked on average 944 more steps per day at 6 months, controlling for relevant demographic and medical factors (dichotomized Model 2:  $\beta=944.0$ ; 95% CI, 107.3–1780.6.;  $p=0.027$ ).

Gratitude for *health* was also associated with greater physical activity, controlling for age and sex (Model 1), after additionally controlling for social variables and medical variables (Model 2), after controlling for depression and anxiety (Model 3), and on the fully adjusted model controlling for optimism (Model 4;  $\beta=340.9$ ; 95% CI, 53.4–628.4;  $p=0.020$ ). Overall, compared to those with lower gratitude ( $n=107$ ), those with the highest rated gratitude for their *health* two weeks after hospitalization ( $n=45$ ) walked on average 1542 more steps per day at 6 months, adjusting for relevant demographic, social, medical and psychological factors (dichotomized Model 4:  $\beta=1542.0$ ; 95% CI, 649.3–2434.6;  $p=0.001$ ). Dispositional gratitude (GQ-6), in contrast, was not associated with physical activity in any of the models.

Regarding self-reported health behavior adherence (also presented in Table 3), baseline gratitude for *life* was associated with greater medical adherence at 6 months on all models (Model 4:  $\beta=0.60$ ; 95% CI, 0.16–1.04;  $p=0.008$ ), as was dispositional gratitude measured by the GQ-6 (Model 4:  $\beta=0.12$ ; 95% CI, 0.0003–0.24;  $p=0.050$ ). Gratitude for *health* was not associated with medical adherence.

Finally, on Cox regression controlling for age and gender, state gratitude items for *life* and *health*, measured 2 weeks post-ACS, were not associated with reduced nonelective cardiac rehospitalizations at 6 months, nor was dispositional gratitude as measured by the GQ-6.

## Discussion

Overall, among ACS patients, items focused on the domains of gratitude for being alive and gratitude for one's health over the past week were – consistent with their design to measure state gratitude – more responsive and dynamic over 6 months than the GQ-6, a measure of dispositional gratitude. Moreover, these state gratitude items, in contrast to the GQ-6, were also prospectively associated with physical activity 6 months later, with the *health* gratitude item's association with physical activity remaining significant even with adjustment for relevant sociodemographic, medical, and psychological factors including optimism. Indeed, those who reported the highest gratitude for their *health* walked 1542 more steps per day 6 months after hospitalization compared to those who reported less gratitude. Gratitude for *life* (though not *health*) was also associated with broader self-reported health behavior

adherence. Neither *life* nor *health* gratitude was prospectively associated with cardiac readmissions.

Our findings that gratitude may be associated with health-related outcomes are consistent with the limited prior literature regarding gratitude and health. In one series of studies by Emmons and McCullough (2003), a summated one-dimensional gratitude measure of *grateful*, *thankful* and *appreciative* ratings was shown to increase after a gratitude intervention, and in one of the three studies – but not the other two – gratitude was associated with increased self-reported activity. Another study in patients with neuromuscular diseases from this series found that a gratitude intervention led to improved sleep quality, increased life satisfaction and a reduction in pain (Emmons & McCullough, 2003). Likewise, in patients with Stage B asymptomatic heart failure, gratitude was associated with better mood and sleep, less fatigue, more-self efficacy, and lower levels of inflammatory biomarkers (Mills et al., 2015). In a pilot follow-up study to explore this experimentally, gratitude journaling showed potential improvements in biomarkers and heart rate variability (Redwine et al., 2016).

These findings are also consistent with a prior project focused on a more state-based assessment of a different positive psychological construct, optimism, in patients undergoing coronary artery bypass graft (CABG) surgery (Scheier et al., 1989). In that study, the authors prospectively examined immediate health/function-specific outcome expectancies (e.g., expectations about time to return to work), in addition to traditional dispositional optimism, and they found that the more recovery-specific and state-based initial assessment was most closely associated with return to life activities following CABG.

To our knowledge, this is the first study to ever examine domain-specific gratitude and its relationship to health outcomes. Gratitude following an ACS is common and could have potentially powerful effects on factors relevant to recovery from a life-threatening event. For example, gratitude has been linked to numerous relevant constructs: self-esteem (Kashdan, Uswatte, & Julian, 2006); dutifulness, achievement striving and self-discipline (Wood et al., 2009); and improved functional status (Emmons & McCullough, 2003). Specific gratitude for being alive in the setting of an acute medical event could, through these factors, catalyze substantial health behavior change and improved medical outcomes. Likewise, gratitude directed toward one's health could prompt a greater focus—and greater behavioral change—on health-related domains such as physical activity.

Our examination of these specific gratitude domains—and the findings regarding their connections to health behaviors—suggest there may be important clinically relevant aspects of gratitude beyond unidimensional dispositional gratitude that appear to have been largely overlooked in health psychology research to date. For example, unlike gratitude for *life* and *health*, the most commonly used measure of dispositional gratitude, the GQ-6, did not show any associations with physical activity, suggesting the possibility that the GQ-6 may not capture certain elements of gratitude relevant to health behaviors and outcomes. Though other scales, such as the Appreciation Scale (Adler & Fagley, 2005) and the Gratitude, Appreciation, and Resentment Test (GRAT) (Watkins et al., 2003) have sought to measure gratitude along more dimensions, none of these scales measure state-based gratitude nor do



they measure aspects of gratitude directly related to one's health, which may be particularly relevant to health behaviors and outcomes after major medical events.

We also found that gratitude for *life* and *health* in the past week exhibited greater temporal change in scores than did the GQ-6. This suggests these items may have been measuring more state-dependent manifestations of gratitude than did the GQ-6. Gratitude has been hypothesized to exist at all levels of psychological affect – as an emotion, as an intermediate mood, and as a dispositional trait (McCullough et al., 2004; Rosenberg, 1998; Alex M Wood et al., 2008). That items for *life* and *health* gratitude felt over the previous week showed greater dynamism than dispositional gratitude (as measured by the GQ-6) suggests future studies should consider evaluating gratitude both at the dispositional and state level when evaluating gratitude and its impact on health.

Of note, there was a substantial ceiling effect for items evaluating gratitude for *family/friends* and *medical staff*, such that a substantial majority of participants gave this item the top rating. Thus, these items did not capture sufficient variance necessary for analyzing these aspects of gratitude. Though they had substantially more variability, the distributions for *life* and *health* gratitude were also skewed and exhibited a ceiling effect. One potential future solution would be to inquire if participants felt a *change* in their overall thankfulness for their life or their health, over a certain period – such as after an event like an ACS – or after an intervention. This alteration to the item may allow for a broader range of responses.

This study had several limitations. First, we used single items to assess state-based and domain-specific gratitude that had not been previously validated. Though single items of happiness, optimism, and other positive constructs have been used in large studies examining relationships between these constructs and health (Abdel-Khalek, 2006; Lau & Knardahl, 2008; Wong & Fielding, 2007), it is likely that refined measures of these preliminary state gratitude constructs – with lesser ceiling effects, greater validation, and multiple items – would allow for a deeper and more rigorous examination of these domains. As single item measures such as those in the present study can be unreliable, and there was no full psychometric testing of these measures, the present findings will need to be replicated with more thoroughly validated measures. Moreover, we suggest that the present study should motivate researchers to develop a psychometrically valid stage gratitude measure that can be used to do so. Second, regarding our findings related to health behaviors, it is possible that those reporting greater gratitude for life or health were in fact healthier, leading to greater participation in health behaviors. However, we did control for ACS severity, prior ACS, and overall medical comorbidity. Finally, regarding sample limitations, this study was conducted at a single academic medical center, with a disproportionate number of White male participants, and a moderate sample size, limiting generalizability.

In sum, in this first study of state-based, domain-specific gratitude and its relationships to post-ACS health behaviors, both gratitude for *life* and *health* were, in contrast to the GQ-6, associated with the primary study outcome of objectively measured physical activity, and gratitude for *life* was linked to broader health behavior adherence. If these findings are replicated in the future with these or more robust measures, it will be important to

understand which elements of thankfulness for one's *life* or *health* may relate to health-related outcomes. Furthermore, it will continue to be important to determine whether gratitude-based interventions—possibly targeting these domain and state specific aspects of gratitude—can have effects on health behaviors and outcomes in patients with heart disease and other medical conditions.

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**Table 1:**

Baseline demographics, medical history, psychological constructs and state gratitude domain means and standard deviations.

	Variable	Baseline	SD
<b>Demographics</b>	Age	61.8	10.7
	Male Sex (N [%])	126 (83%)	--
	White (N [%])	127 (84%)	--
	Living Alone (N [%])	36 (24%)	--
<b>Medical History</b>	Previous ACS (N [%])	63 (41%)	--
	Charlson (age adjusted)	3.3	1.6
	Peak Troponin T	1.5	3.6
<b>Negative Psychological Constructs</b>	Depression (PHQ-9; <i>range: 0–27</i> )	4.31	4.37
	Anxiety (HADS-A; <i>range: 0–21</i> )	4.32	4.08
<b>Positive Psychological Constructs</b>	Optimism (LOT-R; <i>range: 0–24</i> )	17.67	5.65
	Gratitude (GQ-6; <i>range: 6–42</i> )	36.58	5.90
<b>State Gratitude Items</b>	<i>Life</i> State Gratitude	6.03	1.37
	<i>Family/Friends</i> State Gratitude	6.41	1.08
	<i>Health</i> State Gratitude	5.47	1.61
	<i>Medical Staff</i> State Gratitude	6.59	0.92

All values reported as means unless noted. GQ-6 = Gratitude Questionnaire 6 (range ; LOTR = Life Orientation Test Revised (range 6–30); PHQ-9 = Patient Health Questionnaire 9 (range 0–27); HADS-A = 7-item Hospital Anxiety and Depression Scale Anxiety Subscale

**Table 2:**

Baseline and 6 month gratitude and psychological constructs: means and paired t-test results.

	<b>2 Week Mean (SD)</b>	<b>6 Month Mean (SD)</b>	<b>Mean Difference (SD)</b>	<b>95% CI</b>	<b>t- statistic</b>	<b>p- value</b>
<b>Life State Gratitude</b>	6.03 (1.37)	6.30 (1.08)	0.27 (1.33)	0.057 to 0.48	2.51	0.013
<b>Health State Gratitude</b>	5.47 (1.61)	5.91 (1.37)	0.44 (1.59)	0.19 to 0.69	3.42	<0.001
<b>Dispositional Gratitude (GQ-6)</b>	36.58 (5.90)	37.22 (5.14)	0.64 (4.12)	-0.016 to 1.31	1.93	0.056
<b>Optimism (LOTR)</b>	17.67 (5.65)	17.98 (5.83)	0.31 (4.21)	-0.37 to 0.984	0.91	0.37
<b>Depression (PHQ-9)</b>	4.32 (4.38)	3.33 (4.02)	-0.99 (3.51)	-1.55 to -0.42	-3.46	<0.001
<b>Anxiety (HADS)</b>	4.32 (4.08)	3.81 (3.86)	-0.51 (3.45)	-1.07 to 0.039	-1.84	0.068

GQ-6 = Gratitude Questionnaire 6; LOTR = Life Orientation Test Revised; PHQ-9 = Patient Health Questionnaire 9; HADS-A = 7-item Hospital Anxiety and Depression Scale Anxiety Subscale



**Table 3:**

Associations between Baseline Gratitude Variables with 6-Month Physical Activity (mean steps per day) and Medical Adherence

	Model	Physical Activity (Steps)at 6 Months			Medical Adherence (MOS-SAS)		
		$\beta$	95% C.I.	p-value	$\beta$	95% C.I.	p-value
<i>Life State Gratitude</i>	1	323.5	3.1 to 644.0	0.048	0.67	0.32 to 1.03	0.000
	2	359.2	46.4 to 672.1	0.025	0.61	0.25 to 0.98	0.001
	3	301.0	-47.1 to 649.1	0.09	0.71	0.30 to 1.12	0.001
	4	179.5	-193.2 to 552.2	0.34	0.60	0.16 to 1.04	0.008
<i>Health State Gratitude</i>	1	400.9	135.5 to 666.3	0.003	0.25	-0.065 to 0.56	0.12
	2	382.5	116.0 to 649.0	0.005	0.18	-0.14 to 0.51	0.27
	3	367.1	77.4 to 656.8	0.013	0.16	-0.20 to 0.52	0.37
	4	340.9	53.4 to 628.4	0.020	0.13	-0.23 to 0.48	0.48
<i>GQ-6</i>	1	43.9	-30.6 to 118.3	0.25	0.13	0.043 to 0.21	0.003
	2	55.4	-16.3 to 127.2	0.13	0.12	0.036 to 0.21	0.006
	3	34.8	-48.9 to 118.4	0.41	0.15	0.049 to 0.25	0.004
	4	-24.6	-123.8 to 74.7	0.63	0.12	0.0003 to 0.24	0.050

Model 1 = controlling for age and gender (and baseline physical activity); Model 2 = controlling for age, gender, medical and social characteristics; Model 3 = controlling for age, gender, medical and social characteristics, and depression and anxiety; Model 4 = controlling for age, gender, medical and social characteristics, depression, anxiety and optimism; GQ-6 = Gratitude Questionnaire 6; MOS-SAS = Medical Outcomes Study Specific Adherence Scale.